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AUTHOR Cohen, Bethaviva
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ABSTRACT

Factors affecting changes in net tuition revenue in private colleges were studied, and a model accounting for these factors was tested using 1976-1977 and 1977-1978 data. Analysis focused on the influence of tuition price, financial aid, and enrollment. Secondary consideration was given to those institutional characteristics that may distinguish private institutions. Data were obtained from the Higher Education General Information Survey and the College Entrance Examination Board. The primary variables considered were those involved in the direct calculation of net tuition revenue: (1) change in net tuition revenue; (2) change in enrollment; (3) change in financial-aid expenditures; and (4) change in tuition price. A system of four linear equations (one equation per primary variable) was structured (Fig. 2) to relate pairs of variables, with the aim of computing their total effect on net tuition revenue. Three major steps in data analysis were as follows: testing the assumption that reported gross tuition and fees revenue is equal to the product of full-time-equivalent enrollment and the undergraduate tuition price; testing six assumptions about relationships between changes in net tuition revenue, tuition price, financial aid, and enrollment; and examining signs of other relationships between change variables and institutional characteristics. (SW)

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Factors Affecting Net Tuition Revenue at Private Colleges

Working Paper Series

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Factors Affecting Net Tuition Revenue at Private Colleges

Bethaviva Cohen

1982

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Introduction

Several societal trends are converging on postsecondary education simultaneously. These trends are causing administrators to wonder whether they will be able to balance their budgets. As a result, there is a growing interest in how to raise more revenue and in how to predict more accurately the amount of revenue that will be collected. These trends include the demographic decline in the traditional college student population, the economic and political factors that affect private giving, endowment investments, and government expenditures on behalf of postsecondary education, and the inflationary factors that are causing costs to rise faster than revenues.

The pressure to raise more revenues to meet college expenditures brings with it a pressure to raise tuition prices, but there is no guarantee that increased tuition prices will lead to increased revenues, especially after student aid is netted out. While a considerable body of literature has been devoted to the discussion of cost analysis and projections of expenditures, there has been little attention paid to methods for projecting revenues, particularly tuition revenues.

Further, what has been written about the effect of tuition increases has tended to focus on the link between one pair of variables only: tuition price and enrollment. While these variables are clearly crucial to any projection of tuition revenue, it is misleading to ignore the simultaneous interactions of enrollment with financial aid and of tuition price with financial aid. Any real understanding of net tuition revenue must take into account these three relationships between pairs of the three variables that are the basis for calculating net tuition revenue.

This paper has drawn on (1) the literature about the demand for higher education and (2) other research relating tuition price, financial aid, and enrollment. From these, a conceptual model was developed to capsulize the system of factors affecting net tuition revenue--particularly in private colleges. Private colleges are assumed to differ from public colleges in so far as they do not receive a major portion of their operating revenues from a state legislature or a local school district, and their ability to set tuition prices is not constrained by such governmental bodies. The conceptual model derives its face validity from the assumptions about the relationships between the three key variables as expressed in the literature. For example, it is commonly assumed that financial aid induces more students to enroll than would otherwise be the case.

By recasting the conceptual model in mathematical and statistical terms, it was possible to arrive at a formulation that could be applied to historical data about private colleges in 1976-77 and 1977-78. The use of actual data with the model allowed for two things: first, it was possible to see how well the model fitted reality, and second, it was possible to estimate the parameters in the statistical formulation of the model with varying degrees of confidence in the correctness of the resulting values.

While the statistical results derived from fitting the model were not able to account for even fifty percent of the variability in the data, this exercise in research is still valuable for several reasons.

- The model was not discredited, although it may be missing some crucial variables. This difficulty was to be expected because certain pieces of desirable data, notably those items that might measure institutional quality, had to be discarded for technical reasons. With a different data base, it may be possible to overcome this limitation of the results.

- The model can be used as a benchmark for judging the behavior of college administrators. If a model predicated on commonly held assumptions about college policies does not fit reality, the cause may be that the administrators are acting contrary to the assumptions. For example, if certain steps would rationally lead to the maximization of net tuition revenue and yet these steps are not being followed (as evidenced by less than maximal revenues), the cause may be managerial policies are being formulated or executed with other goals in mind.

- With the conceptual model intact, it may be fruitful to replicate the statistical analysis using time series data for a single institution or cross-sectional data for a set of peer institutions, again surmounting problems with quality of the data. Not only would there be a better chance of attaining consistently significant results with a more homogeneous data base, but there would be more justification for applying the results to a particular college's situation.

- Even if the study is not replicated, it is useful to have some numbers based on national data to get a qualitative sense of the relationships between variables in the system of factors affecting net tuition revenue at private colleges and possibly some sense of the order of magnitude of the effects of these factors on each other.

- Finally, to the extent that this research study falls short of the expectations or standards of other researchers in the areas of college budgeting and the demand for higher education, it may stimulate those scholars to conduct further research of their own in the area of revenue projection. The amount of information available to college policymakers will be increased whether others build on the model set forth in this study or use a different approach to the problem at hand. The important thing is to raise the level of knowledge in this area beyond its current underdeveloped state.

This paper opens with a discussion of the importance of tuition and fees as a source of income for private colleges. When thinking about this income source, it is important to look at <u>net</u> tuition and fees revenue, not just gross tuition and fees revenue. The literature available to an administrator attempting to understand this revenue item is of limited value because (a) it tends to focus on just one pair of factors affecting net tuition revenue at a time (for example, tuition price and enrollment, or financial aid and enrollment), (b) it does not always move from the discussion of the factors studied to their revenue implications, and (c) it generally does not describe research done at an institutional level.

If net tuition and fees revenue is defined as gross tuition and fees revenue less institutional financial-aid expenditures, the factors directly involved in calculating <u>changes</u> in this revenue item are the <u>changes</u> in tuition

price, financial aid, and enrollment and the base values for tuition price and enrollment. To the extent that various institutional characteristics, such as campus setting and quality, directly affect changes in tuition price, financial aid, and enrollment, these same institutional characteristics will have an indirect effect on changes in the college's net tuition revenue. By organizing these direct and indirect effects into a system of four equations, it may be possible to estimate the total effect of any one variable on changes in net tuition revenue.

I. Background

Tuition Revenue in Private Colleges

As the costs facing higher education continue to escalate, there is a greater need to understand and to project the revenues that institutions will have available for meeting instructional costs. In the case of private colleges, it is particularly critical to understand the portion of the revenue stream derived from students, since this is the primary source of current operating funds in most private institutions in the United States.

Smith and Henderson (1976) found that it is possible to categorize institutions of higher education by significant revenue sources. Their empirical analysis of financial patterns at 2,859 American colleges and universities resulted in a taxonomy consisting of five clusters, each dominated by one of the following funding sources: (1) tuition, (2) endowment income, (3) annual private giving, (4) sponsored research revenue, and (5) state and local appropriations. In their study, approximately 90 percent of the private institutions fell into clusters 1 and 3. Almost half of the private colleges fell into cluster 1, with the mean percentage of educational and general revenue from tuition equal to 78 percent. While annual private giving was a significant percentage of educational and general revenues for schools in cluster 3 (an average of 34 percent), tuition was still the source of more than half of the educational and general revenues (an average of 52 percent).

This central role of tuition revenue in private colleges is further accentuated by the factors affecting other sources of income. First, a downturn in the business climate due to recession and inflation coupled with people questioning the value of higher education is affecting the amount of private gifts, the return on colleges' endowment investments, and the funds made available by private foundations for sponsored research. Second, government appropriations for all sectors of higher education may be reduced under more conservative spending policies spurred by the taxpayer revolt of the late 1970's. What funds are appropriated will be sought after in an atmosphere of increased competition between public and private institutions as all colleges face inflation-driven costs.

Tuition revenue is also important as a source of income over which private college administrators have some control (Cyert 1975). When a college must raise more money to meet rising costs, public institutions do not have the same freedom to raise tuition levels because they are usually guided in tuition policies by the state legislature or tied to system-wide policies. Finally, consumers may be willing to accept increased tuition charges to the same extent that they accept increases in the prices of other goods and services. This means that tuition revenues at least have a chance of keeping pace with inflation as a source of revenue for off-setting inflation driven increases in institutional expenditures.

Gross Versus Net Tuition Revenue

An important characteristic of tuition revenue is its interpretation as the level of support afforded an institution by its students (Dickmeyer and Hughes 1979). However, it may be misleading to look at gross tuition revenue,

as a meaningful measure of student support because gross tuition and fees revenue is the total of all funds that would be collected from students if every student paid the full tuition price. (Essentially, it is the number of students enrolled multiplied by the annual tuition charge.) However, net tuition revenue (defined as gross tuition and fees income less institutional financial-aid expenditures) is actually the more logical measure of student support for an institution, since student aid expenditures are supported by sources of income other than students (Nelson 1978; O'Neill 1973).

The techniques for estimating revenues have not been refined in detail because budgeting tended to focus on expenditures during the time that college enrollments were growing. In particular, the basic method for estimating tuition revenues still consists of taking the product of the tuition rate in a future year and the expected FTE enrollment for that year (Dozier, Howard, Jenkins, and Williams 1980; Hopkins and Massy 1977). This often means that the revenue projection is reduced to an enrollment projection made by the registrar or director of admissions (National Association of College and University Business Officers 1968). This simple formulation leads to the general notion that a decrease in enrollment will probably mean a decrease in tuition revenue (Academy for Educational Development 1979; Caruthers and Orwig 1979; Ginsburg 1975).

The Web of Factors Affecting Net Tuition Revenue

If a college anticipates a demographic decline in enrollment that will reduce tuition income if the tuition price remains the same. or if a college must raise money to meet rising costs, a common policy alternative is to raise tuition. It is not uncommon to find that a college has set its tuition and fees on the basis of revenue needs or with only minimal consideration of the sensitivities of its student market (Huddleston and Batty 1978, p. 41). In fact, there are many factors that affect tuition revenue and all of them should be considered together before instituting a new policy. The difficulty with trying to consider all of these factors is that their effects are entangled in a veritable spider's web of conflicting forces.

For example. increased tuition charges can be used to recover some of the revenue lost when enrollments decline for demographic reasons. At some point. the tuition charge itself may contribute to a decline in enrollment (Caruthers and Orwig 1979). Because of this relationship between tuition and enrollment, Hopkins and Massy (1977) have suggested that the extent of this relationship. called the price elasticity of demand (in economics), should be estimated and a student demand equation should be inserted into any algorithm used for forecasting tuition revenues. The research effort to quantify the effect of tuition price on enrollment comprises an entire literature in itself. Reviews of this literature may be found in: California Postsecondary Education Commission (1980), Cohen (1980), Cohn and Morgan (1978), Dresch (1975), Jackson and Weathersby (1975), McPherson (1978), and Weinschrott (1977).

However, because we have said that the relevant quantity is net tuition revenue (rather than gross tuition revenue), the impact of price increases goes beyond the direct effect on enrollment. For example. college financial aid policies also have a direct effect on enrollment. College financial aid policies are based on the assumption that student financial assistance can

offset the adverse enrollment effect of raising tuition levels (Academy for Educational Development 1979). While an increase in financial aid may help increase or maintain enrollments, it can also cause a decrease in net tuition revenue. This is often ignored as Meeth (1974) has pointed out:

> Many college administrators see increased enrollment as the path away from a deficit operation and, consciously or subconsciously, make growth a primary purpose of their institutions. Increased enrollment by itself, however, is part of the economic problem of the small college. not the solution. Unless or until students pay the full cost of their education, growth means greater expenditures, not savings. [P. 155]

There are still other expenses connected with increasing or maintaining enrollment that are not considered in the traditional calculation of net tuition revenue. Colleges are allocating greater portions of their budgets to recruitment to attract new students and to counseling and tutoring to retain the students already enrolled (Caruthers and Orwig 1979). Ideally, a long-range budget forecasting program should incorporate the links and feedback loops that relate the costs of such marketing activities and student aid with enrollment levels and tuition rates (Hopkins and Massy 1977).

Such a method of revenue projection would have the advantage of reflecting the consequences of management decisions, in addition to incorporating the impact of environmental variables such as the economic and demographic trends colleges already consider (Caruthers and Orwig 1979). It does not seem that this complete model has yet been put into operation for private college budgeting. The smaller institutions for which such models could be most useful are not equipped to develop them. On the other hand, schools with resources to develop such a model do not worry as much about the responsiveness of enrollment to tuition increases and so consciously omit such feedback loops (Hopkins and Massy 1977).

In addition to considering the effects of changes in tuition price. financial aid, and enrollment--variables that are all involved directly in the calculation of net tuition revenue--on changes in net tuition revenue and on each other, there are other factors. Institutional characteristics may cause slightly different patterns of effects to occur. The indirect effects of these institutional characteristics on net tuition revenue must also be understood and taken into account. In considering enrollment trends and the factors that contribute to an understanding of the selection of an individual school by a prospective student, researchers have identified: financial condition, reputation, size. location (Centra 1980), annual costs, convenience. whether the student believes he or she would be admitted, traditional relationships with the institution such as church or high school ties, whether the institution offers the desired program, persuasion, and whim or accident (Mayhew 1979). In the specific cases of private institutions, Mayhew emphasizes the importance of distinctiveness of program, smaller size. reputation, high selectivity. drawing students from beyond the local area, rural location, and institutional dependence on tuition revenue.

In short, there is a tangled web of factors whose effects on net tuition revenue must be untangled in order to understand the net tuition revenues an institution will realize at a particular price level or with a particular

financial aid policy or with a particular admissions policy. At the center of this web are the factors directly involved in the calculation of net tuition revenue (enrollment, financial aid, and tuition price). Around the edges of the web are all the characteristics that distinguish institutions from each other and have an Indirect impact on net tuition revenue. For a more detailed discussion of the literature on the factors directly affecting net tuition revenue, see Cohen, A Structural Model of Factors Affecting Net Tuition Revenue in Private Colleges, 1980.

A Proposed Model of the Web of Factors Affecting Net Tuition Revenue

A pictorial display of possible interactions of factors that affect net tuition revenue is shown in figure 1. Of the six possible relationships between pairs of the four variables--change in net tuition revenue, change in tuition price, change in financial-aid expenditure, and change in enrollment--every relationship can be found explicitly or implicitly in the literature. Specifically, these relationships can be summarized as follows:

Assumption 1:

Changes in enrollment affect changes in net tuition revenue. Probably if all other things remain the same, an increase in enrollment is likely to result in an increase in net tuition revenue, because there are more students to pay the advertised price.

Assumption 2:

Changes in financial-aid expenditures affect changes in net tuition revenue. In this case, if all other things remain the same, an increase in financial aid is related to a decrease in net tuition revenue because more discounts have been given to the institution's customers.

Assumption 3:

Changes in tuition price affect changes in net tuition revenue. Intuitively, if all other things remain the same, an increase in tuition price is related to an increase in net tuition revenue because the price to each customer is higher.

Assumption 4:

Changes in financial-aid expenditures affect changes in enrollment. It is generally assumed that, all other things being equal, students will choose the school whose cost is discounted the most.

Assumption 5:

Changes in tuition price affect changes in enrollment. It is generally assumed that, all other things being equal, students will choose the school that costs the least.

Assumption 6:

Changes in tuition price affect changes in financial aid. It is generally assumed that, all other things remaining the same. the impact of tuition price increases by discounting the tuition price with financial aid should mitigate the problem.

While these assumptions are predicated on all other things remaining the same. the fact is that all other things do not remain the same. The assumptions, therefore, cannot be considered in isolation from each other. If we express graphically these assumptions using arrows to represent the hypothesized impact of one variable on another, we can see how difficult it may be to predict the effect of initially changing just one variable. This is because a change in one variable is likely to trigger changes in the other variables.

Figure 1 shows the relationships between changes in net tuition revenue and the variables involved in its calculation. Each relationship is represented in the figure by an arrow that is numbered to correspond to one of the assumptions listed above. Each arrow points to the probable result of a change in the variable at the tail of the arrow. The figure also shows that institutional characteristics have direct effects on the factors used to calculate net tuition revenue thereby allowing the institutional characteristics to have indirect effects on net tuition revenue.

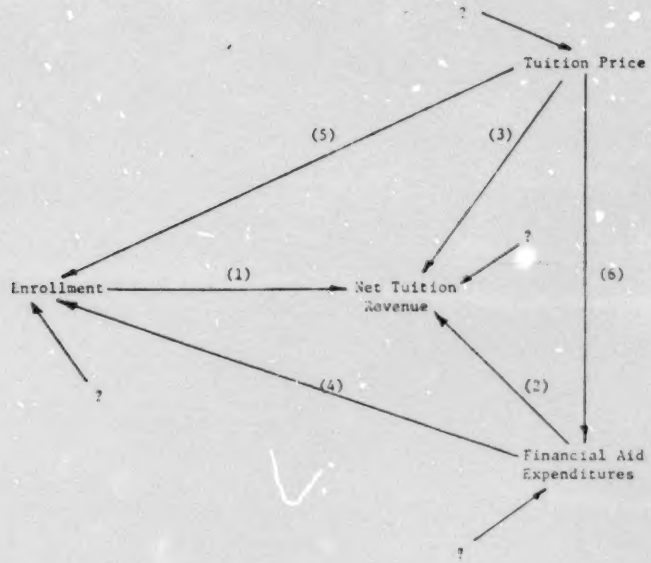

Fig. 1. Relationships assumed to exist between change in net tuition revenue, change in tuition price, change in financial aid expenditures, and change in enrollment

II. Method

Research Design

The objective of the research study whose findings are discussed in this report was to identify those factors found to have a systematic effect on increases or decreases in net tuition revenue at private colleges and assess the extent of those effects. The study was limited to private colleges because of their high dependence on tuition as a source of revenue. Since even among private colleges there are different emphases on the missions of teaching, research, and public service that influence revenue and expenditure patterns, separate analyses were run for different types of private colleges using the NCHEMS taxonomy (Makowski 1979) for postsecondary institutions.

The primary factors studied were those directly involved in the calculation of net tuition revenue, that is tuition price, financial aid, and enrollment. Secondary consideration was given to those institutional characteristics that may distinguish different private institutions from each other. Two of these institutional characteristics, type of institution and size of student body, were used to stratify the sample of approximately 1,000 non-specialized private colleges and universities. Other institutional characteristics, selected from the wealth of data available using factor analysis and data quality considerations, were entered directly into the analysis with the primary factors.

Previous studies in this general policy area have either used a specialized survey of individual students or have gone to the other extreme and used aggregate data for all the institutions of higher education in a state. With the possibility of facilitating the application of any findings to the problems of individual institutions, this study was designed to use data resulting from a survey of institutions (rather than students or states). Thus, it is possible that individual institutions would be able to collect similar data items about their peer institutions and use the methodology outlined in this study to replicate the study results for themselves.

As Radner and Miller (1975) have pointed out:

> Effective policy analysis requires, of course, not just good projections based on the assumption of unchanging trends but also estimates of how policy instruments affect target variables . . . [P. 2]

This study was designed to emphasize the understanding how policies about tuition, financial aid and enrollment might affect the target variable net tuition revenue. The results of the design was a behavioral model that is less accurate than a forecasting model (Weinschrott 1977). When it comes down to specific numbers, a behavioral model makes explicit all the underlying assumptions that might be modified rather than assuming that they will never change. It, therefore, can be left in the background as in using trend analysis for forecasting.

The behavioral model developed consists of four linear equations, one for each change variable mentioned in assumptions 1-6. As is the case with all models, this one is clearly a simplification of reality. If one assumes that

net tuition revenue is approximately the product of enrollment and tuition minus financial aid, the change in net tuition revenue from one school year to the next is not a simple linear combination of the changes in enrollment, tuition, and financial aid. In fact, one can compute the relationship between change in net tuition revenue and the other variables, by substracting the expressions for net tuition revenue in two consecutive years. One discovers that the change in net tuition revenue is equal to the sum of four terms: base tuition times the change in enrollment, base enrollment times the change in tuition price, change in enrollment times change in tuition price, and minus one times the change in financial-aid expenditures.

The statistical technique best suited to investigating the relationship between continuous variables is multiple regression. Here, multiple regression was used to look for the existence of the relationships in assumptions 1-6 and of any relationships between institutional characteristics and the change variables directly involved in the calculation of changes in net tuition revenue. The regression coefficients were interpreted as indications of the direction and strength of those relationships. The analytical tool used for doing the regression analysis was SPSS--the Statistical Package for the Social Sciences (Nie, Hull, Jenkins, Steinbrenner, and Bent 1975; Anderson and Sinha 1980).

Sources of Data

The data were drawn from two sources. One source was the Higher Education General Information Survey (HEGIS) of the National Center for Higher Education Statistics (NCES). This survey collects information on institutional finances, fall enrollments, employees, and other characteristics of over three thousand institutions of higher education across the United States. This study used information collected about private colleges in the 1976-77 and 1977-78 administrations of HEGIS, which were the most up-to-date, complete, and uniform surveys available in July 1980.

The second source of data used in the study was a computer tape of the information used in preparing the College Entrance Examination (CEEB) College Handbook (16th ed.) for 1976-77. It included about two-thirds of the private institutions in the HEGIS file. Data elements contained on the tape provided information about general institutional characteristics, curriculum, admissions, student life, annual expenses, and financial aid.

The data were divided into 10 groups using the NCHEMS taxonomy for postsecondary institutions and FTE enrollment in 1976-77. The number of cases in each group is based on those private institutions (excluding such specialized schools as law schools, divinity schools, etc.) reporting tuition in 1976-77 and 1977-78 and reporting full-time first-time freshmen in 1976-77 to HEGIS. Two schools were excluded for inconsistencies in enrollment figures. Table 1 describes each group in terms of a category in the NCHEMS classification scheme and, when a category was subdivided, in terms of 1976-77 FTE enrollment. For each group, the geographic distribution of schools across the United States is given both in absolute numbers and also in terms of percentages.

Table 1
Definition of Ten Groups of Private Institutions and
Their Geographic Distribution Across the United States

Class and Size	Geographic Region					Total
	R1	R2	R3	R4	R7	
Major Doctoral	34	10	6	9		59
	57.6%	16.9%	10.2%	15.3%		
Comprehensive						
1-2499	23	7	8	24		62
	37.1%	11.3%	12.9%	38.7%		
over 2499	35	13	9	18	3	78
	44.9%	16.7%	11.5%	23.1%	3.8%	
Two Year						
1-499	52	37	37	19		145
	35.9%	25.5%	25.5%	13.1%		
over 499	37	14	22	3	6	82
	45.1%	17.1%	26.8%	3.7%	7.3%	
General Baccalaureate						
1-499	36	31	22	18		107
	33.6%	29.0%	20.6%	16.8%		
500-749	31	41	42	14	1	129
	24.0%	31.8%	32.6%	10.9%	.8%	
750-999	21	47	37	15		120
	17.5%	39.2%	30.8%	12.5%		
1000-1499	35	47	32	16		130
	26.9%	36.2%	24.6%	12.3%		
over 1499	44	42	26	11	3	126
	34.9%	33.3%	20.6%	8.7%	2.4%	
Grand Total	//////////////////////////////////					1038

Notes:
Size in FTE students enrolled 1976-77.
R1= North Atlantic States
R2= Great Lakes - Plains States
R3= Southeastern States
R4= Western - Southwestern States
R7= Canal Zone, Guam, Puerto Rico. and Virgin Islands

Variables

From among all the data in the HEGIS Surveys of 1976-77 and 1977-78 and College Handbook for 1976-77, 20 variables were selected for inclusion in the analysis. The primary variables considered were those that are involved in the direct calculation of net tuition revenue: change in net tuition revenue, change in enrollment, change in financial-aid expenditures, and change in tuition price. Sixteen variables that represent institutional characteristics and may have indirect effects on net tuition revenue were also included in the analysis. In any attempt to adapt this analysis for a particular institution or group of institutions rather than a national survey, there may be better measures of institutional characteristics available. In particular, the quality of information about (1) institutional selectivity or (2) quality available nationally in machine-readable form, was not high enough to warrant its inclusion in this statistical analysis. Also, the use of factor analysis to select a nonredundant set of variables from all the variables available introduces a measure of arbitrariness into the choice process. Another subset of variables may be just as good or possibly even better.

Variables in the Calculation of Change in Net Tuition Revenue

DNTR = Change in net tuition revenue for school year 1977-78 over 1976-77

DATP = Change in advertised typical undergraduate tuition price for 1977-78 over 1976-77

DFAE = Change in institutional financial-aid expenditures for 1977-78 over 1976-77

DFTE = Change in FTE enrollment for 1977-78 over 1976-77

Institutional Characteristics

All of these variables are based on measurements for the school year 1976-77 only.

Annual Student Expenses

X178 = Advertised typical undergraduate tuition prices

FAE77 = Institutional scholarships and fellowships (financial-aid expenditure)

X47 = Percentage of students from in-state

X48 = Percentage of students in college housing

PROFIT = For - profit institution (coded yes or no)

X52 = Percentage of students from minority background

R1-R4 = Region of the United States (coded yes or no for each region)

Curriculum

X63 = Percentage of undergraduates choosing Engineering

Financial Characteristics (which may be proxies for institutional characteristics comprising a school's reputation)

FC2 = Dedication to students welfare (that is, student services expenditures as percentage of total E&G expenditures)

FC3 = Reliance on student support (that is, gross tuition and fees revenue as percentage of total current fund revenues)

FC4 = External support for institutional financial aid (that is, restricted scholarships and fellowships expenditures as a percentage of total scholarships and fellowships expenditures)

FC5 = Dedication to institutional financial aid (that is, total scholarships and fellowships expenditures as percentage of gross tuition and fees revenue)

Quality

SFR = Student-faculty ratio (that is, total FTE enrollment divided by total number of full-time faculty)

Statistical Analysis

The assumptions about the relationships between the primary variables can be represented and assessed statistically by estimating a system of four linear equations -- one equation for each primary variable. Multiple regression is the statistical technique best suited to analyzing a single continuous variable, such as change in tuition price or percentage of students from in-state. Discrete yes or no variables can also be incorporated as dummy variables with yes corresponding to 1 and no corresponding to 0.

In this study, rather than having a single linear equation to estimate, there was a system of four equations:

$$DATP = b_{01} + c_{11} X_1 + \ldots + e_1 \quad (1)$$

$$DFAE = b_{02} + b_{12}\,DATP + c_{12}\,X_1 + \ldots + e_2 \quad (2)$$

$$DFTE = b_{03} + b_{13}\,DATP + b_{23}\,DFAE + c_{13}\,X_1 + \ldots + e_3 \quad (3)$$

$$DNTR = b_{04} + b_{14}\,DATP + b_{24}\,DFAE + b_{34}\,DFTE + c_{14}\,X_1 + \ldots + e_4 \quad (4)$$

where,

DATP, DFAE, DFTE, and DNTR have already been defined as the the changes in tuition price, financial aid, enrollment, and net tuition revenue, respectively.

X_1 .... represent the secondary variables defined above that may or may not enter into a particular equation for a particular group of institutions,

b_{IJ} = the direct effect of the I-th primary variable on the J-th primary variable when the values of all other variables are held constant,

c_{kJ} = the direct effect of the k-th secondary variable on the J-th primary variable when the values of all the other variables are held constant,

e_J = the random or stochastic (vs. systematic) component of the behavior of the J-th primary variable, that is the disturbance introduced into the system by factors not explicitly mentioned.

Ordinary least squares estimation techniques (here, the REGRESSION procedure of SPSS) were used to estimate the b's and c's in this multi-equation system. The use of this technique requires the assumption that the variables in the core of the system do not have reciprocal impacts on one another and that any errors are not due to the systematic omission of the same variables from all four equations.

The individual regression coefficients, bIJ, can be interpreted as the measure of the direct effects or assumptions charted in figure 1, earlier. Figure 2 specifically shows how some of the regression coefficients of equations 1-4, that is the b's, correspond to assumptions 1-6 relating the variables involved in the calculation of change in net tuition revenue to one another. Also in figure 2, one can see how the c's relate the institutional characteristics to the variables directly involved in the calculation of change in net tuition revenue.

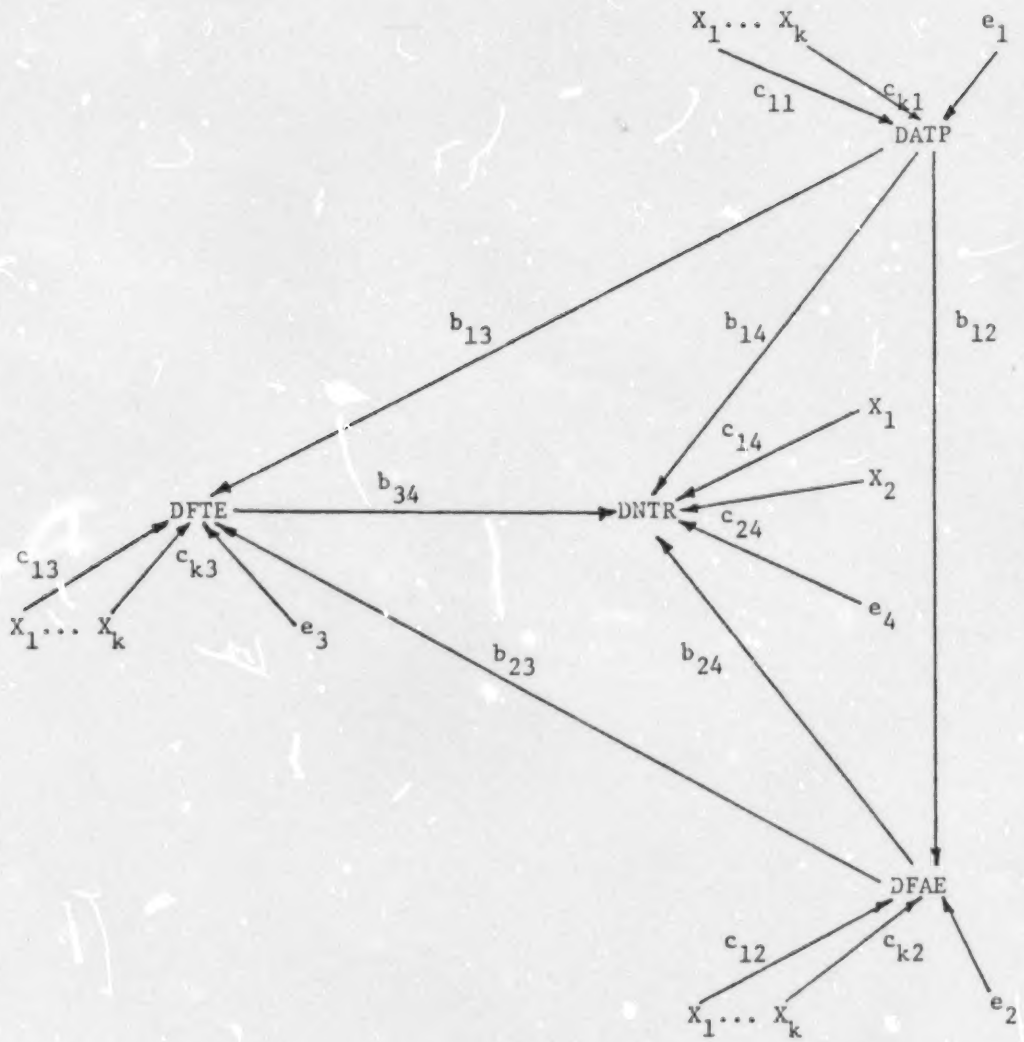

Fig. 2. How regression coefficients from equations 1-4 relate pairs of variables

Now, using figure 2, it becomes a simple matter of tracing out the total effects of the variables (rather than just the direct effects). This is important. For example, when the tuition price changes, not only does it have a direct effect on net tuition revenue, but also an indirect effect through enrollment and financial-aid expenditures that are also hypothesized to depend on tuition price.

This becomes clearer when we see that in order to compute the total effect of a unit change in tuition price (DATP) on change in net tuition revenue (DNTR), it is simply a matter of tracking all possible paths from DATP to DNTR and summing the effects contributed by each route:

b_{14}	$+b_{12}\ b_{24}$	$+b_{13}\ b_{34}$	$+b_{12}\ b_{23}\ b_{34}$
the direct path to DNTR	the path through DFAE	the path through DFTE	the path through DFAE and DFTE

A similar computation could be made to determine the effect of any variable which enters on the right hand side of one of equations 1-4.

Whenever equations 1-4 are estimated with sufficiently accurate data and the best subset of institutional characteristics, it should be possible to compute the total effect of each institutional characteristic on net tuition revenue by reducing the system to a single equation. This reduction is effected by successively substituting the expressions for the primary variables into equation 4. That is, first replace DFTE with equation 3; next replace all occurrences of DFAE (there will be two now) in the modified equation 4 with equation 2; finally, replace all occurrences of DATP (there will be three) with equation 1. The resulting reduced-form equation should contain only institutional characteristics that influence changes in net tuition revenue (DNTR) indirectly through the change variables, except for base enrollment (X101) and base tuition price (X178), which also affect DNTR directly.

It is important that this approach be used in looking at how institutional characteristics affect net tuition revenue if one is to understand the mechanism by which each one might affect net tuition revenue. For example, while one might get very similar numbers (corresponding to the total effects) by directly estimating the equation

$$DNTR = t_0 + t_1 X_1 + t_2 X_2 + \ldots + t_k X_k + e$$

for the change in net tuition revenue as a function of the institutional characteristics X<1>, X<2>, ..., X<k>, one would not understand why or how institutional characteristic X<I> happened to have total effect t<I> on the change in net tuition revenue (Hanushek and Jackson 1977, pp. 227-28). One would have no way of knowing which path the effect followed in going from the institutional characteristic to net tuition revenue. For example, the institution's geographic region could be important in estimating changes in net tuition revenue because it affects the institution's tuition policies or enrollments or both. This understanding can only come from looking at the

complete structure of relationship, as is done in figure 2 using the system of equations.

III. FINDINGS

Design and Limitations of Analysis

This discussion of the findings is divided into three sections to correspond to the three major steps in the data analysis:

1. Test the assumption that Reported Gross Tuition and Fees Revenue is equal to the product of FTE enrollment and the undergraduate tuition price. This provides the basis for believing that enrollment and tuition price, taken together with financial aid, are the central factors in the calculation of changes in net tuition and fees revenue.

2. Test the six assumptions about relationships between changes in net tuition revenue, tuition price, financial aid, and enrollment. These relationships show the connections between policy variables directly entering into the calculation of net tuition revenue.

3. Look for signs of other relationships between change variables and institutional characteristics. These relationships reflect a second level of complexity: the connections between institutional characteristics and net tuition revenue that are generally mediated by the three basic policy variables of enrollment, financial aid, and tuition.

In actuality, steps 2 and 3 consisted of a single statistical computation: that of estimating equations 1-4. The discussion of findings will be clearer, however, if they are treated as separate steps.

The findings of the study are limited in their generalizability by several considerations. As in all nonexperimental designs, it is assumed that the results can only be generalized to the extent that the underlying structure does not change. In particular, the findings would not follow if there were changes in college pricing policy, such as the introduction of a voucher system, or tax credits, or if public colleges started charging full-cost tuition prices. Further, the results do not show what will happen if any of the policy variables are changed, but only what patterns have existed historically. There is no way to use nonexperimental data to prove one thing actually causes another.

The generalizability of the results are also limited by the fact that the findings of the study are based on a limited set of measurements for a specific sample of the population of private colleges at two specific points in time. This limitation will be compounded to the extent that any of the measurements used did not accurately reflect reality, that is, any data quality problems.

Since the findings are based on the use of the REGRESSION procedure of SPSS, the results are subject to statistical and technical limitations. The explanatory power of the regression equations is reduced to the extent that all of the influential factors are not controlled for. Certain variables not easily measured for individual private institutions in a national sample (such as the number of high school graduates in that institution's market, prevailing wage rates, unemployment rates, and tuition prices at competing institutions) were not considered for inclusion in the analysis. Other variables may have

been in the data base, but were omitted because of their quality. or because not all of the variables could be included. Technical considerations stem from the built-in limitations of using SPSS (pre-release version 8.0) at a Hewlett/Packard 3000 computer installation.

Policy Components of Net Tuition Revenue

In order to increase one's understanding of net tuition revenue (which is gross tuition revenue minus institutional financial aid), it is necessary to back up one step and make sure of which factors affect gross tuition revenue. Together with institutional financial aid, the factors affecting gross tuition revenue form the basis for understanding net tuition revenue. Intuitively,

gross tuition + fees revenue = enrollment x tuition price

It was actually possible to examine the applicability of this equation to the data for private colleges. At the same time. this examination established enrollment and tuition price as the basic determinants of gross tuition revenue. and the extent to which equation 4 simplifies reality by being a linear equation.

The test of whether or not gross tuition revenue equals enrollment times tuition price consisted of using the SPSS REGRESSION procedure to estimate the regression of reported gross tuition and fees revenue on the product. FTE enrollment X undergraduate tuition price. The results of the estimation are reported on table 20 for 1976-77 and on table 26 for 1977-78.

Each line of tables 2-1 and 2-2 corresponds to a particular type of private college. The first piece of information on a line is the actual regression estimates--both the constant term and the coefficient for the product of enrollment with tuition. Under the coefficients, their respective standard errors of estimate are given in parentheses. Next the F statistic and appropriate degress of freedom are given as evidence for supposing that the multiple correlation coefficient is different from zero. Finally, the square of the multiple correlation is given. In 1976-77. the product of enrollment with tuition explained from 79 to 96 percent of the variation in reported gross tuition revenue. In 1977-78, the product explained from 80 to 96 percent of the variation, depending on the type of institution.

Table 2-1
Estimated Regression Equation for Reported Gross Tuition and Fees Revenue on FTE Enrollment x Undergraduate Tuition Price in 1976-77

Class and Size	a + b*ENR*TUIT (se[a]) (se[b])	F Degrees of Freedom	R^2
Major Doctoral	-179.96 +1.06 ENR*TUIT (970.30) (.03)	1437.88 (1, 57)	.962
Comprehensive			
1-2499	403.57 + .90 ENR*TUIT (172.97) (.04)	546.16 (1,60)	.901
over 2499	967.96 + .95 ENR*TUIT (488.93) (.04)	545.66 (1,76)	.879
Two Year			
1-499	38.44 + .95 ENR*TUIT (20.34) (.04)	655.33 (1,142)	.822
over 499	-394.19 +1.32 ENR*TUIT (156.96) (.07)	306.43 (1, 79)	.795
General Baccalaureate			
1-499	31.74 +1.02 ENR*TUIT (33.62) (.04)	589.18 (1,104)	.850
500-749	128.19 + .93 ENR*TUIT (40.96) (.03)	1095.06 (1,127)	.896
750-999	107.59 + .97 ENR*TUIT (85.18) (.04)	532.55 (1,118)	.819
1000-1499	270.12 + .92 ENR*TUIT (79.68) (.03)	1283.29 (1,128)	.909
over 1499	183.23 + .97 ENR*TUIT (186.77) (.03)	837.45 (1,124)	.871

Notes:

Reported Gross Tuition and Fees Revenue in thousands of dollars.
Undergraduate Tuition Price in thousands of dollars.
Enrollment in FTE students.
Class and Size are based on NCHEMS taxonomy and FTE enrollment in 1976-77.

Table 2-2
Estimated Regression Equation for Reported Gross Tuition and Fees Revenue on FTE Enrollment x Undergraduate Tuition Price in 1977-78

Class and Size	a + b*ENR*TUIT (se[a]) (se[b])	F Degrees of Freedom	R^2
Major Doctoral	177.49 +1.05 ENR*TUIT (983.86) (.03)	1678.83 (1, 57)	.967
Comprehensive			
1-2499	430.24 + .91 ENR*TUIT (216.86) (.04)	433.59 (1, 60)	.878
over 2499	429.40 +1.02 ENR*TUIT (394.64) (.03)	1130.07 (1, 76)	.937
Two Year			
1-499	36.89 + .96 ENR*TUIT (18.41) (.03)	1053.85 (1,142)	.881
over 499	-93.77 +1.08 ENR*TUIT (111.62) (.05)	481.43 (1, 79)	.859
General Baccalaureate			
1-499	39.47 +1.03 ENR*TUIT (43.65) (.05)	423.83 (1,104)	.803
500-749	129.65 + .95 ENR*TUIT (39.94) (.03)	1404.15 (1,127)	.917
750-999	172.12 + .97 ENR*TUIT (91.26) (.04)	560.69 (1,118)	.826
1000-1499	255.62 + .93 ENR*TUIT (90.34) (.03)	1186.68 (1,128)	.902
over 1499	256.72 + .99 ENR*TUIT (197.87) (.03)	934.30 (1,124)	.883

Notes:

Reported Gross Tuition and Fees Revenue in thousands of dollars.
Undergraduate Tuition Price in thousands of dollars.
Enrollment in FTE students.
Class and Size are based on NCHEMS taxonomy and FTE enrollment in 1976-77.

From the basic regression results. it was possible to compute a 95 percent confidence interval around the coefficient of enrollment x tuition price. If the number one was in the confidence interval. there is a good chance that the product neither overestimated nor underestimated the reported revenue figure.

In 1976-77. using the product FTE enrollment x tuition price to estimate gross tuition revenue would have resulted in an overestimate of gross tuition and fees revenue at small comprehensive colleges, at small general baccalaureate institutions and at large baccalaureate institutions. At large two-year colleges, the product seemed to underestimate reported revenue. In these four types of institutions, further evidence of the poor predictive power of the product for estimating gross tuition revenues was the fact that the constant terms were significantly different from zero at the .05 level using a two-tailed test. In 1977-78, the product continued to be an overestimate at small comprehensive colleges and large baccalaureate institutions.

The failure of such a commonly held belief to be absolutely true may be due to the fact that large numbers of part-time or special students pay tuition on a different basis (for example. per credit) than students enrolled for a regular load of courses. Alternatively, the results encountered may be due to incorrect reporting of tuition and fee revenue on the HEGIS Financial Statistics Survey. Schools may be adjusting the revenue figure for tuition remissions or other financial aid when the figure asked for is supposed to be all the tuition <u>charged against</u> students.

The fact that gross tuition revenue might not be exactly equal to the product of FTE enrollment and tuition price should alert college planners to see which multiple (other than 1.0) will give the best predictions of gross tuition revenue at their own institutions. This does not detract from the fact that the variables <u>enrollment</u> and <u>tuition</u> together accounted for at least 80 percent of the variability in gross tuition revenue figures and thus, together with financial aid, form the critical triad of variables for investigating net tuition revenue. Therefore, the research could proceed confident in the belief that the logically important variables--enrollment, financial aid, and tuition price--were also the statistically important variables in calculating net tuition revenue.

Test of Assumptions about Factors Entering Calculation of Net Tuition Revenue

The purpose of the next part of the analysis was to test the assumptions that were made about the existence and direction of relationships between the variables directly involved in the calculation of net tuition revenue. These assumptions were stated earlier on pages 13-14. Assumption 1-6 about the relationships between the four change variables were examined by estimating equations 1-4 with the SPSS procedure REGRESSION. The basic structure of the equations was derived from assumptions 1-6 and supplemented with those institutional characteristics which seemed to increase the amount of explained variance in each dependent variable.

The regression coefficients of the change variables and their corresponding standard errors of estimate are given in table 3-1 (for those that were estimated) together with the simple correlation coefficient for each

of the six pairs of variables. Each column in table 3-1 shows the results for one of the ten types of private colleges examined.

When we look at the three numbers in the first column and the first row of table 3-1, we see that the simple correlation between change in net tuition revenue and change in enrollment for doctoral institutions was .467. The two asterisks indicate that .467 was so much greater than zero, that a number this positive would only result from a distribution of correlation coefficients centered around a zero or negative true value by chance less than 1.25 percent of the time. Further, in the regression equation with change in net tuition revenue as the dependent variable, a change in enrollment of 1 FTE student was associated with an increase of $440 in net tuition revenue (if all other things remain constant) subject to a standard error of $141. That means there is only about a 60 percent chance that the interval from $299 to $581 will surround the true value of the regression coefficient. Looking at the sixth row of the first column of table 3-1, we see that the simple correlation between change in financial aid and change in tuition was significantly greater than zero, but that the coefficient for change in tuition price in the equation with change in financial-aid expenditure as the dependent variable was not estimated (indicated by #).

Notes for Table 3-1

a. Simple correlation coefficient (*$p<.05$,**$p<.0125$ for test of hypothesis against one-tailed alternative)

   Estimated regression coefficient and standard error in parentheses

b. Money in thousands of dollars

   Enrollment in FTE students

   Change measured between 1976-77 and 1977-78

\# No regression equation was found to estimate the regression coefficient for which the ratio of the estimated coefficient to its standard error had a magnitude greater than 1.00

N = 51, 54, 73, 86. 54, 84, 114, 121, and 119 respectively for the different types of institution reading across the table column headings

Table 3-1

Evidence[a] for 6 Basic Hypotheses at Different Types of Private Institutions

Variables[b] in Hypothesis and Predicted Direction of Relationship	NCHEMS Class and 1976-77 FTE Enrollment				
	Doctoral	Comprehensive 1-2499	Comprehensive over 2499	Two Year 1-499	Two Year over 499
1. Change in Net Tuition Revenue	.467**	.258*	.348**	.577**	-.274
Change in Enrollment (+)	.440	1.050	.519	1.136	-.061
	(.141)	(.372)	(.152)	(.146)	(.298)
2. Change in Net Tuition Revenue	-.082	-.347**	-.281**	-.082	-.644**
Change in Financial Aid Expenditure (-)	-.710	-.848	-.577	-.767	-3.087
	(.148)	(.214)	(.230)	(.182)	(.645)
3. Change in Net Tuition Revenue	.031	-.031	.196*	.202*	.137
Change in Tuition Price (+)	4561.909	-309.759	1174.273	157.710	9.024
	(2209.951)	(392.205)	(862.686)	(48.898)	(530.748)
4. Change in Enrollment	-.106	.137	-.113	.306**	.232*
Change in Financial Aid Expenditure (+)	-.188	.081	#	.364	.421
	(.145)	(.074)		(.118)	(.268)
5. Change in Enrollment	-.290*	-.089	.146	-.039	-.051
Change in Tuition Price (-)	-3104.880	#	#	#	#
	(1868.538)				
6. Change in Financial Aid Expenditure	.293*	-.037	-.021	.164	-.144
Change in Tuition Price (+)	#	#	#	47.758	-156.840
				(29.670)	(90.785)

Table 3-1 (continued)

Evidence[a] for 6 Basic Hypotheses at Different Types of Private Institutions

Variables[b] in Hypothesis and Predicted Direction of Relationship	NCHEMS Class and 1976-77 FTE Enrollment General Baccalaureate 1-499	500-749	750-999	1000-1499	over 1499
1. Change in Net Tuition Revenue Change in Enrollment (+)	.392** 1.011 (.260)	.541** 2.013 (.161)	.496** 1.176 (.117)	.382** .742 (.146)	.531** 1.201 (.164)
2. Change in Net Tuition Revenue Change in Financial Aid Expenditure (-)	.238 .481 (.276)	-.813** -.902 (.043)	-.419** -.950 (.106)	-.521** -.830 (.107)	-.080 -.464 (.210)
3. Change in Net Tuition Revenue Change in Tuition Price (+)	.056 126.866 (118.814)	.121 115.917 (86.554)	.172* 258.632 (98.732)	.302** 395.744 (166.846)	-.115 -96.489 (302.866)
4. Change in Enrollment Change in Financial Aid Expenditure (+)	.044 .118 (.114)	-.129 #	.129 #	-.117 #	.153 .161 (.114)
5. Change in Enrollment Change in Tuition Price (-)	-.234* -105.021 (47.794)	-.015 #	-.164* -101.776 (68.069)	.021 #	-.244** -505.779 (160.581)
6. Change in Financial Aid Expenditure Change in Tuition Price (+)	.205 72.771 (43.601)	-.075 -253.766 (132.376)	.035 #	.001 #	.175* 174.402 (119.704)

Assumption 1

Looking across the first row on table 3-1. we find that the null hypothesis--changes in enrollment have no effect on changes in net tuition revenue--could be rejected for nine of the ten groups at the .0125 level in favor of the alternative that increases in enrollment have a positive direct effect on net tuition revenue. For the larger two-year colleges, the estimated regression coefficient was negative (contrary to expectation) but not significantly different from zero at the .05 level.

Assumption 2

Looking across the second row on table 3-1. we find that the null hypothesis--changes in financial-aid expenditure have no effect on changes in net tuition revenue--could be rejected for nine of the ten groups at the 0.5 level in favor of the alternative that increases in financial-aid expenditure have a negative direct effect on net tuition revenue. Only for the smallest baccalaureate institutions did increase in financial-aid expenditure have a significant positive direct effect on net tuition revenue.

Assumption 3

Looking across the third row on table 3-1. we find that the null hypothesis--changes in tuition price have no effect on changes in net tuition revenue--could be rejected for four of the ten types of private schools at the 0.5 level in favor of the alternative that increases in tuition price have a positive direct effect on net tuition revenue. In another four groups, the estimated regression coefficient was positive. but not significantly different from zero at the 0.5 level. For small comprehensive colleges and the largest baccalaureate institutions, the estimated regression coefficient was negative (contrary to expectations), but not significantly different from zero at the 0.5 level.

Assumption 4

Looking at the fourth row of table 3-1. In only one group could the null hypothesis--changes in financial-aid expenditure have no effect on changes in enrollment-- be rejected at the .0125 level in favor of the alternative that increases in financial-aid expenditure are related to increases in enrollment. In another four cases, the estimated regression coefficient was positive. but not significantly different from zero at the .05 level. Only for the doctoral institutions was the regression coefficient negative (contrary to expectations), but it was not significantly different from zero at the .05 level. In the remaining four cases, no regression model was found where this regression coefficient could be estimated to be at least as large as its standard error.

Assumption 5

Looking at the fifth row on table 3-1, we find that in two groups the null hypothesis--changes in tuition price have no effect on changes in enrollment--could be rejected at the .05 level in favor of the alternative that increases in tuition price are related to decreases in enrollment. In another two groups the estimated regression coefficients were also negative. but not

significantly different from zero at the .05 level. In the remaining six groups, no regression model was found where the coefficient of change in tuition price was greater than its standard error, so no conclusions could be drawn about the relationship in these cases.

Assumption 6

Looking at the sixth row of table 3-1. in only one subfile could the null hypothesis--changes in tuition price have no effect on changes in financial-aid expenditure--be rejected at the .05 level. The alternative hypothesis is that increases in tuition price are related to increases in financial-aid expenditures. In another two cases the regression coefficient was positive but not significantly different from zero at the .05 level. For small baccalaureate institutions and larger two-year colleges, the regression coefficient was negative (contrary to expectations) and significantly different from zero at the .05 level. In the other five cases, no regression model was found where this regression coefficient could be estimated to be at least as large as its standard error.

Summary

The essential nature of the relationships between the pairs of change variables is summarized on table 3-2. For example. looking down the second column of table 3-2, we see that at small, comprehensive, private colleges the following relationships were observed.

1. A change in enrollment had a positive direct effect on net tuition revenue, all other things remaining constant. That is, increases in enrollment tended to be associated with increases in net tuition revenue.

2. A change in financial-aid expenditure had a negative direct effect on net tuition revenue. all other things remaining constant. That is, increases in financial-aid expenditures tended to be associated with decreases in net tuition revenue.

3. The direct effect of a change in tuition price on net tuition revenue was neither consistently positive or negative. Further investigation is called for.

4. The direct effect of a change in financial-aid expenditures on enrollment was neither consistently positive or negative. Further investigation is called for.

5. No information could be extracted from the data about the relationship between a change in tuition price and changes in enrollment.

6. No information could be extracted from the data about the relationship between a change in financial-aid expenditures and a change in tuition price.

Each column in table 3-2 can be interpreted similarly for institutions of that of NCHEMS class and size. Each entry in table 3-2 may be interpreted as information about the likely sign of the corresponding regression coefficient--one of the b's--in equations 1-4.

Note for Table 3-2:

Using the figures reported in table 3-1, the relationship between a pair of variables is reported as

Positive if the regression coefficient is at least as large as twice its standard error,

Negative if the regression coefficient is negative and at least as large in magnitude as twice its standard error,

Zero if the magnitude of the ratio of the regression coefficient to its standard error is less than twice its standard error.

No relationship is reported if the pair of variables did not both appear in one of the equations used to estimate the regression parameters.

Each entry in table 3-2 may be interpreted as being one of the b's in figure 2 which relates one change variable to another change variable.

Table 3-2

Relationships Observed Between Pairs of Change Variables at Ten Different Types of Private Institution

Variables and Expected Relationship	NCHEMS Class and 1976-77 FTE Enrollment				
	Doctoral	Comprehensive 1-2499	Comprehensive over 2499	Two Year 1-499	Two Year over 499
1. Change in Net Tuition Revenue / Change in Enrollment (Positive)	Positive	Positive	Positive	Positive	Zero
2. Change in Net Tuition Revenue / Change in Financial Aid Expenditure (Negative)	Negative	Negative	Negative	Negative	Negative
3. Change in Net Tuition Revenue / Change in Tuition Price (Positive)	Positve	Zero	Zero	Positive	Zero
4. Change in Enrollment / Change in Financial Aid Expenditure (Positive)	Zero	Zero		Positive	Zero
5. Change in Enrollment / Change in Tuition Price (Negative)	Zero				
6. Change in Financial Aid Expenditure / Change in Tuition Price (Positive)				Zero	Zero

Table 3-2 (continued)

Relationships Observed Between Pairs of Change Variables at Ten Different Types of Private Institution

Variables and Expected Relationship	NCHEMS Class and 1976-77 FTE Enrollment: General Baccalaureate 1-499	500-749	750-999	1000-1499	over 1499
1. Change in Net Tuition Revenue / Change in Enrollment (Positive)	Positive	Positive	Positive	Positive	Positive
2. Change in Net Tuition Revenue / Change in Financial Aid Expenditure (Negative)	Zero	Negative	Negative	Negative	Negative
3. Change in Net Tuition Revenue / Change in Tuition Price (Positive)	Zero	Zero	Positive	Positive	Zero
4. Change in Enrollment / Change in Financial Aid Expenditure (Positive)	Zero				Zero
5. Change in Enrollment / Change in Tuition Price (Negative)	Negative		Zero		Negative
6. Change in Financial Aid Expenditure / Change in Tuition Price (Positive)	Zero	Zero			Zero

Empirical Relationships between Change Variables and Institutional Characteristics

Having looked at the effect on net tuition revenue of the change variables directly involved in the calculation of changes in net tuition revenue, the study proceeded to look at the direct effect of institutional characteristics on the primary variables. These effects are suggested by the regression coefficients of the variables measured only in the base year of the study -- X<1>,X<2>,...,X<k> of equations 1-4. If a regression coefficient was significantly different from zero at the .05 level for a particular type of private college, a tentative proposition about the effect of the institutional characteristic was formulated.

Tables 4-1 through 4-10 summarize the signs of the regression coefficients of the institutional characteristics--the c's in equations 1-4—with each table corresponding to a particular type of institution. For example, looking at table 4-4 for small two-year colleges, the first column of information shows that in the regression equation with change in tuition price as the dependent variable, the variables "Undergraduate Tuition 1976-77" and "For-Profit Institution" had estimated coefficients not significantly different from zero; the coefficient of Student Aid Expenditure 1976-77 was significantly greater than zero; and the coefficient of Student Aid Expenditures as a Percentage of Gross Tuition & Fees Revenue was significantly less than zero. The other variables did not appear in the estimation of equation 1 for this group of institutions.

Notes for tables 4-1 to 4-10:

The relationship between a change in variable and an institutional characteristic is reported as

Positive If the regression coefficient of the institutional variable in the equation with the change variable as the dependent variable is positive and twice as large in magnitude as its standard error,

Negative If the regression coefficient of the institutional variable in the equation with the change variable as the dependent variable is negative and twice as large in magnitude as its standard error,

Zero If the magnitude of the regression coefficient was not at least twice as large as its standard error.

No relationship is reported if the institutional characteristic was not selected for inclusion in the equation used to estimate the regression parameters for a particular change variable.

Each entry in tables 4-1 to 4-10 may be interpreted as being one of the c's in figure 2 that relates an institutional characteristic to change variable.

Geographic regions and For-Profit Institution are dummy variables, which are 1 if the characteristic applies and 0 otherwise;
All money is in thousands of dollars;
Enrollment in FTE students for 1976-77;
All percents are between 0 and 100, inclusive;
All ratios are positive.

Table 4-1

Observed Relationships Between Change Variables and Institutional Characteristics for Ten Different Types of Private Institution

NCHEMS Class: Major Doctoral	CHANGE IN Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic				
Great Lakes-Plains	zero			
Southeast				
West-Southwest	zero			
Undergraduate Tuition 1976-77	positive			zero
Student Aid Expenditure 1976-77				
FTE Enrollment 1976-77		zero	positive	positive
Student Services as Percent of E&G Expenditures		negative		
Gross Tuition&Fees Revenue as Percent of Total Revenue		zero		
Unrestricted Scholarships as Percent of Student Aid Expenditure				
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue				
Student-Faculty Ratio	zero			
Ratio of Full-time Undergrads to Full-time First-time Freshmen				
Percent In-State		negative		
Percent in College Housing				
Percent Minority Background		positive		
Percent Engineering Majors			zero	
Percent Total Aid Awarded in Grants				

Table 4-2

Observed Relationships Between Change Variables and Institutional Characteristics for Ten Different Types of Private Institution

NCHEMS Class: Comprehensive 1976-77 FTE Enrollment: 1-2499	CHANGE IN Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic				
Great Lakes-Plains				
Southeast				
West-Southwest			zero	
Undergraduate Tuition 1976-77	zero			zero
Student Aid Expenditure 1976-77				
FTE Enrollment 1976-77				positive
Student Services as Percent of E&G Expenditures				
Gross Tuition&Fees Revenue as Percent of Total Revenue	positive			
Unrestricted Scholarships as Percent of Student Aid Expenditure			zero	
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue		negative		
Student-Faculty Ratio	zero			
Ratio of Full-time Undergrads to Full-time First-time Freshmen			negative	
Percent In-State			zero	
Percent In College Housing				
Percent Minority Background		zero		
Percent Engineering Majors				
Percent Total Aid Awarded In Grants				

Table 4-3

Observed Relationships Between Change Variables and Institutional Characteristics for Ten Different Types of Private Institution

NCHEMS Class: Comprehensive 1976-77 FTE Enrollment: over 2499	CHANGE IN Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic				
Great Lakes-Plains	zero			
Southeast				
West-Southwest		zero		
Undergraduate Tuition 1976-77		zero		zero
Student Aid Expenditure 1976-77		negative		
FTE Enrollment 1976-77		zero	negative	positive
Student Services as Percent of E&G Expenditures				
Gross Tuition&Fees Revenue as Percent of Total Revenue	positive		positive	
Unrestricted Scholarships as Percent of Student Aid Expenditure				
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue			negative	
Student-Faculty Ratio	zero		negative	
Ratio of Full-time Undergrads to Full-time First-time Freshmen	negative		zero	
Percent In-State			negative	
Percent In College Housing	positive			
Percent Minority Background		zero		
Percent Engineering Majors				
Percent Total Aid Awarded in Grants			negative	

Table 4-4

Observed Relationships Between Change Variables and Institutional Characteristics for Ten Different Types of Private Institution

NCHEMS Class: Two Year 1976-77 FTE Enrollment: 1-499	CHANGE IN Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic				
Great Lakes-Plains			zero	
Southeast				
West-Southwest				
Undergraduate Tuition 1976-77	zero		zero	positive
Student Aid Expenditure 1976-77	positive	negative		
FTE Enrollment 1976-77		positive		positive
Student Services as Percent of E&G Expenditures				
Gross Tuition&Fees Revenue as Percent of Total Revenue			zero	
Unrestricted Scholarships as Percent of Student Aid Expenditure		zero		
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue	negative			
Student-Faculty Ratio				
Ratio of Full-time Undergrads to Full-time First-time Freshmen			negative	
Percent In-State				
Percent In College Housing		zero	positive	
Percent Minority Background				
Percent Engineering Majors			zero	
Percent Total Aid Awarded In Grants				
For-Profit Institution	zero		zero	

Table 4-5

Observed Relationships Between Change Variables and Institutional Characteristics for Ten Different Types of Private Institution

NCHEMS Class: Two Year 1976-77 FTE Enrollment: over 499	CHANGE IN Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic				
Great Lakes-Plains			zero	
Southeast	zero	positive	negative	
West-Southwest		zero	negative	
Undergraduate Tuition 1976-77	positive		negative	zero
Student Aid Expenditure 1976-77		zero		
FTE Enrollment 1976-77		positive	positive	negative
Student Services as Percent of E&G Expenditures	negative	zero	zero	
Gross Tuition&Fees Revenue as Percent of Total Revenue				
Unrestricted Scholarships as Percent of Student Aid Expenditure	negative	zero		
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue				
Student-Faculty Ratio			negative	
Ratio of Full-time Undergrads to Full-time First-time Freshmen		positive	negative	
Percent In-State		negative		
Percent in College Housing				
Percent Minority Background	zero	positive		
Percent Engineering Majors				
Percent Total Aid Awarded In Grants	positive	positive		
For-Profit Institution	positive			

Table 4-6

Observed Relationships Between Change Variables and Institutional Characteristics for Ten Different Types of Private Institution

NCHEMS Class: General Baccalaureate 1976-77 FTE Enrollment: 1-499	CHANGE IN Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic				
Great Lakes-Plains				
Southeast	zero		zero	
West-Southwest				
Undergraduate Tuition 1976-77	positive		zero	zero
Student Aid Expenditure 1976-77	positive		positive	
FTE Enrollment 1976-77		zero	negative	zero
Student Services as Percent of E&G Expenditures				
Gross Tuition&Fees Revenue as Percent of Total Revenue	negative			
Unrestricted Scholarships as Percent of Student Aid Expenditure				
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue	negative	zero	negative	
Student-Faculty Ratio	zero			
Ratio of Full-time Undergrads to Full-time First-time Freshmen		zero	zero	
Percent In-State	positive			
Percent In College Housing				
Percent Minority Background				
Percent Engineering Majors				
Percent Total Aid Awarded In Grants				

Table 4-7

Observed Relationships Between Change Variables and Institutional Characteristics for Ten Different Types of Private Institution

NCHEMS Class: General Baccalaureate 1976-77 FTE Enrollment: 500-749	CHANGE IN Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic	zero		zero	
Great Lakes-Plains				
Southeast			zero	
West-Southwest		positive		
Undergraduate Tuition 1976-77	positive			zero
Student Aid Expenditure 1976-77				
FTE Enrollment 1976-77		zero		positive
Student Services as Percent of E&G Expenditures				
Gross Tuition&Fees Revenue as Percent of Total Revenue				
Unrestricted Scholarships as Percent of Student Aid Expenditure		negative	zero	
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue		negative		
Student-Faculty Ratio	negative			
Ratio of Full-time Undergrads to Full-time First-time Freshmen			zero	
Percent In-State		negative	positive	
Percent In College Housing			zero	
Percent Minority Background			positive	
Percent Engineering Majors		zero		
Percent Total Aid Awarded in Grants		positive		

Table 4-8

Observed Relationships Between Change Variables and Institutional Characteristics for Ten Different Types of Private Institution

NCHEMS Class: General Baccalaureate 1976-77 FTE Enrollment: 750-999	CHANGE IN Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic			positive	
Great Lakes-Plains				
Southeast	negative			
West-Southwest	negative		positive	
Undergraduate Tuition 1976-77	positive	positive		positive
Student Aid Expenditure 1976-77				
FTE Enrollment 1976-77		zero	zero	zero
Student Services as Percent of E&G Expenditures		zero		
Gross Tuition&Fees Revenue as Percent of Total Revenue			zero	
Unrestricted Scholarships as Percent of Student Aid Expenditure		zero		
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue			negative	
Student-Faculty Ratio				
Ratio of Full-time Undergrads to Full-time First-time Freshmen	zero	zero	negative	
Percent In-State				
Percent in College Housing	positive			
Percent Minority Background	negative			
Percent Engineering Majors				
Percent Total Aid Awarded in Grants				

Table 4-9

Observed Relationships Between Change Variables and Institutional Characteristics for Ten Different Types of Private Institution

NCHEMS Class: General Baccalaureate 1976-77 FTE Enrollment: 1000-1499	CHANGE IN Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic				
Great Lakes-Plains				
Southeast				
West-Southwest				
Undergraduate Tuition 1976-77	positive		zero	positive
Student Aid Expenditure 1976-77				
FTE Enrollment 1976-77	zero			zero
Student Services as Percent of E&G Expenditures		positive		
Gross Tuition&Fees Revenue as Percent of Total Revenue				
Unrestricted Scholarships as Percent of Student Aid Expenditure		zero		
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue	positive		positive	
Student-Faculty Ratio	positive		negative	
Ratio of Full-time Undergrads to Full-time First-time Freshmen			negative	
Percent In-State		zero		
Percent In College Housing	zero		negative	
Percent Minority Background				
Percent Engineering Majors		zero		
Percent Total Aid Awarded In Grants			zero	

Table 4-10

Observed Relationships Between Change Variables and Institutional Characteristics for Ten Different Types of Private Institution

NCHEMS Class: General Baccalaureate 1976-77 FTE Enrollment: over 1499	CHANGE IN Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic	zero		zero	
Great Lakes-Plains				
Southeast	zero		negative	
West-Southwest				
Undergraduate Tuition 1976-77	zero		negative	positive
Student Aid Expenditure 1976-77				
FTE Enrollment 1976-77				positive
Student Services as Percent of E&G Expenditures			positive	
Gross Tuition&Fees Revenue as Percent of Total Revenue				
Unrestricted Scholarships as Percent of Student Aid Expenditure				
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue	zero	positive		
Student-Faculty Ratio		negative	negative	
Ratio of Full-time Undergrads to Full-time First-time Freshmen			negative	
Percent In-State	negative		negative	
Percent In College Housing		zero	negative	
Percent Minority Background				
Percent Engineering Majors		zero		
Percent Total Aid Awarded in Grants	positive	positive	positive	

The Effect of Institutional Characteristics

The same relationships between pairs of variables suggested in tables 4-1 to 4-10 can also be stated in prose. as propositions which might be explored futher. Table 5 shows the correspondence between the entries on tables 4-1 to 4-10 and the list of propositions presented below. For example. looking at table 5, the proposition that relates Percent In-State and Change In Student Aid Expenditure is proposition A5. This would help someone reading table 4-1 understand what is meant by the entry negative in the row labeled Percent In-State and the column labeled Change In Student Aid Expenditure. Eventually, this proposition would be combined with information about all the ways in which changes in student aid expenditures can affect changes in net tuition revenue to explain the various ways in which the percent of in-state students at an institution can indirectly affect changes in net tuition revenue.

Table 5
Correspondence of Observed Relationships
in Tables 4-1 through 4-10 with Propositions A1-D6

NCHEMS Class: / 1976-77 FTE Enrollment:	CHANGE IN: Tuition Price	Student Aid Expenditure	Enrollment	Net Tuition Revenue
North-Atlantic Great Lakes-Plains Southeast West-Southwest	A1	A2	A3	
Undergraduate Tuition 1976-77	D3	D4	D5	D6
Student Aid Expenditure 1976-77	C1	C2	C3	
FTE Enrollment 1976-77	B1	B2	B3	B4
Student Services as Percent of E&G Expenditures	B18	B19	B20	
Gross Tuition&Fees Revenue as Percent of Total Revenue	D1		D2	
Unrestricted Scholarships as Percent of Student Aid Expenditure	C7	C8		
Student Aid Expenditure as Percent of Gross Tuition&Fees Revenue	C4	C5	C6	
Student-Faculty Ratio	B5	B6	B7	
Ratio of Full-time Undergrads to Full-time First-time Freshmen	B8	B9	B10	
Percent In-State	A4	A5	A6	
Percent in College Housing	B11	B12	B13	
Percent Minority Background	B14	B15	B16	
Percent Engineering Majors				
Percent Total Aid Awarded in Grants	C9		C10	
For-Profit Institution	B17			

The propositions are grouped under four headings: geographic region/market, campus community, financial aid, and tuition. The subgroups of general baccalaureate institutions are distinguished in the discussion below by the adjectives: smallest, small, medium size. large and largest, respectively.

Geographic Region/Market

Proposition A1. There was a negative relationship between being in the Southeast or West-Southwest and changes in tuition price for medium-sized baccalaureate institutions.

Proposition A2. There was a positive relationship between region and changes in financial-aid expenditures for large two-year colleges in the Southeast and for small baccalaureate institutions in the West-Southwest.

Proposition A3. There was a negative relationship between region and changes in enrollment for the largest baccalaureate institutions in the Southeast and for the large two-year colleges in the Southeast and the West-Southeast. There was a positive relationship for medium-sized general baccalaureate institutions in the West-Southwest and the North Atlantic region.

Proposition A4. The relationship between percentage of students from in-state and changes in tuition price was positive for the smallest baccalaureate institutions and negative for the largest baccalaureate institutions. One interpretation of this would be that very small colleges with captive populations have more latitude to raise tuition prices while very large colleges have more latitude to raise tuition prices if they have more of a national market.

Proposition A5. The relationship between percentage of students from in-state and change in financial-aid expenditures was negative for doctoral institutions, small baccalaureate institutions, and large two-year colleges. Again, this could be interpreted to mean that schools with captive student populations do not have to expend as much on financial aid.

Proposition A6. The relationship between percentage of students from in-state and change in enrollment was negative for large comprehensive colleges and the largest baccalaureate institutions. The relationship was positive for small baccalaureate institutions. This might be interpreted to mean that the largest comprehensive colleges and baccalaureate institutions suffered reduced enrollments if they were not able to draw a nationwide pool; small baccalaureates made slight gains in enrollment if they drew on a local pool of students.

Campus Community

Proposition B1. Within each group of institutions, size of FTE enrollment was not related to size of tuition increase.

Proposition B2. At two-year colleges, changes in financial-aid expenditures were directly proportional to FTE enrollment.

Proposition B3. There was a positive relationship between FTE enrollment and changes in FTE enrollment at doctoral institutions and large two-year colleges. There was a negative relationship at large comprehensive colleges and the smallest baccalaureate institutions.

Proposition B4. There was a positive relationship between FTE enrollment and changes in net tuition revenue at doctoral institutions, comprehensive institutions, small baccalaureate institutions, very large baccalaureate institutions, and small two-year colleges. The relationship was negative for large two-year colleges.

Proposition B5. Within each group of institutions, student-faculty ratio was not significantly related to changes in tuition prices.

Proposition B6. There was a negative relationship between student-faculty ratio and changes in financial-aid expenditure at the largest baccalaureate institutions.

Proposition B7. There was a negative relationship between student-faculty ratio and changes in enrollment at large comprehensive colleges, at the larger baccalaureate institutions, and at large two-year colleges. This might be interpreted to mean that large institutions with relatively small numbers of faculty were not as attractive to students as comparable sized institutions with more faculty members.

Proposition B8. There was a negative relationship between the ratio of undergraduates to freshmen and changes in tuition price for large comprehensive colleges.

Proposition B9. There was a positive relationship between ratio of undergraduates to freshmen and changes in financial-aid expenditures at large two-year colleges. This may be interpreted to mean that new financial aid is targeted at freshmen.

Proposition B10. There was a negative relationship between the ratio of undergraduates to freshmen and changes in enrollment at small comprehensive colleges, at baccalaureate institutions of at least medium size. and at two-year colleges. This may be interpreted to mean that low freshmen enrollments presage overall enrollment declines at all but doctoral institutions.

Proposition B11. There was a positive relationship between the percentage of students living in college housing and changes in tuition price for large comprehensive colleges and medium size baccalaureate institutions. This may be interpreted to mean that residential campuses have more flexibility in raising tuition prices.

Proposition B12. There was a positive relationship between the percentage of students living in college housing and changes in financial-aid expenditures for small two-year colleges. This may be interpreted to mean that small residential two-year colleges spend more on financial aid to induce students to attend.

Proposition B13. There was a negative relationship between the percentage of students in college housing and changes in enrollment at the larger baccalaureate institutions. This may indicate a lessening of the popular advantage of large residential liberal-arts colleges in attracting students.

Proposition B14. There was a negative relationship between the percentage of students of minority background and changes in tuition price at medium sized baccalaureate institutions. This may be interpreted to mean that colleges try to anticipate the amount of increased tuition that minority students can bear.

Proposition B15. There was a positive relationship between the percentage of minority students and changes in financial aid at doctoral institutions and large two-year colleges.

Proposition B16. There was a positive relationship between percentage of minority students and changes in enrollment at small baccalaureate institutions.

Proposition B17. At two-year colleges, there was a positive relationship between being a for-profit institution and changes in tuition price. This may be interpreted to mean that for-profit institutions feel they have more flexibility or more need to make larger than average tuition increases.

Proposition B18. There was a negative relationship between the level of expenditures on student services and changes in tuition price for large two-year colleges.

Proposition B19. There was a negative relationship between the level of expenditure on student services and changes in expenditures on financial aid at doctoral institutions. The relationship was positive at large baccalaureate institutions.

Proposition B20. There was a positive relationship between the level of expenditure on student services and changes in enrollment at the largest baccalaureate institutions.

Financial Aid

Proposition C1. There was a positive relationship between the absolute level of financial-aid expenditure and changes in tuition price at the smallest baccalaureate institutions and at small [illegible]-year colleges. This may be interpreted to mean that high levels of [illegible]nancial aid may give very small institutions a sense of flexibility in raising tuition prices.

Proposition C2. There was a negative relationship between the actual level of financial-aid expenditures and changes in financial-aid expenditures at large comprehensive colleges and all two-year colleges.

Proposition C3. There was a positive relationship between the level of financial-aid expenditures and changes in enrollment at the smallest baccalaureate institutions.

Proposition C4. There was a negative relationship between the percentage of tuition charges paid for with institutional financial aid and changes in tuition price at the smallest baccalaureate institutions and small two-year colleges. There was a positive relationship at large baccalaureate institutions. The former may be interpreted as a conservative management style at very small institutions--spending a lot of financial aid and not raising tuition very much. The latter may be interpreted as an attempt to cover the expense of more financial aid by charging higher tuition (to those who can pay).

Proposition C5. There was a positive relationship between the percentage of tuition charges paid for with institutional financial aid and changes in financial-aid expenditures at small comprehensive colleges and the largest baccalaureate institutions. The relationship was negative at small baccalaureate institutions.

Proposition C6. There was a negative relationship between the percentage of tuition charges paid for with institutional financial aid and changes in enrollment at the largest comprehensive colleges and at the smallest and medium size baccalaureate institutions. The relationship was positive at large baccalaureate institutions. This may be interpreted to mean that high percentages of expenditures on financial aid do not guarantee steady or increasing enrollment trends.

Proposition C7. There was a negative relationship between the percentage of scholarship money from unrestricted funds and changes in tuition price at the largest two-year colleges. This may be interpreted as a sign of a double-barreled attempt to ward off enrollment declines by using institutional funds for financial aid while limiting tuition increases.

Proposition C8. There was a negative relationship between the percentage of scholarship money from unrestricted funds and changes in financial-aid expenditures at small baccalaureate institutions.

Proposition C9. There was a positive relationship between the percentage of total aid awarded as grants (vs. loans or jobs) and changes in tuition price at the largest baccalaureate institutions and large two-year colleges. This may be interpreted to mean that colleges that rely heavily on grants feel that their students will be more willing to accept higher tuition increases.

Proposition C10. There was a negative relationship between percentage of total aid in grants and changes in enrollment at large comprehensive colleges. The relationship was positive at the largest baccalaureate institutions. This may be interpreted as meaning that grants enhance the popularity of large baccalaureate institutions but they do not insulate large comprehensive colleges from other factors affecting their popularity adversely.

Tuition

Proposition D1. There was a positive relationship between the percentage of revenue coming from tuition and fees and changes in tuition price at large comprehensive colleges. The relationship was negative at the smallest baccalaureate institutions. The latter may be interpreted as indicating a

reluctance on the part of schools that are highly dependent on tuition revenues to raise tuition prices.

Proposition D2. There was a positive relationship between the percentage of revenue coming from tuition and fees and changes in enrollment at large comprehensive colleges.

Proposition D3. There was a positive relationship between tuition price level and changes in tuition price for doctoral institutions, for all but the largest baccalaureate institutions, and for large two-year colleges.

Proposition D4. There was a positive relationship between tuition price level and changes in financial-aid expenditures at medium size baccalaureate institutions.

Proposition D5. There was a negative relationship between tuition price level and changes in enrollment at the largest baccalaureate institutions and large two-year colleges. This may be interpreted to mean that high prices are not perceived as being synonymous with quality, which would make an institution more popular.

Proposition D6. There was a positive relationship between tuition price level and changes in net tuition revenue at the baccalaureate institutions of at least medium size and at small two-year colleges.

Estimating the Total Effects

For each type of institution in the study, logically combining the true propositions about the indirect effects of institutional characteristics on net tuition revenue of the preceding section with the true assumptions about the web of the relationships between the variables directly involved in calculating changes in net tuition revenue. the potential for calculating the total effect of any particular variable on net tuition revenue would exist.

If figure 2 were redrawn for each type of institution, the total effect of any particular institutional characteristic on changes in net tuition revenue would be the sum of effects along each path in the diagram connecting that variable to change in net tuition revenue. Computationally, this reduction can be accomplished by substituting equation 1 into equation 2, then substituting equation 1 and the revised equations 2 and 3 into equation 4.

The result of this process is a series of equations for change in net tuition revenue. initially containing all the change variables and institutional characteristics but eliminating one change variable at each step in the process. The final reduced form equation contains only the institutional characteristics.

Numerical values are not presented here for the total effects because there is no assurance that the total effects are statistically different from zero. This is further necessitated by the fact that some of the values of R>[2] obtained when estimating equations 1-4 were not even .50.

Since the main concern of the research reported here was to study the impact of various factors on net tuition revenue, one might ask why there is a need to estimate more than one equation. One could simply estimate the regression of changes in net tuition revenue on the institutional characteristics and stop there. This very question is asked (and answered) in the literature (Hanushek and Jackson 1977, pp. 227-28).

It is not enough to look just at the relationship between the institutional characteristics and changes in net tuition revenue. The effect of the institutional characteristics is only <u>indirect</u>. The nature of the impact of institutional characteristics on net tuition revenue depends very much on the nature and structure of the connections--the paths--between the institutional characteristics and net tuition revenue. Therefore, it is important to investigate both the effect of institutional characteristics on the variables directly involved in calculating changes in net tuition revenue and the effect of the variables in the calculation on net tuition revenue itself. The result of this kind of two-stage investigation is then a simplified picture (or model) of what may actually be causing fluctuations in net tuition revenue.

In the original study, the total effects were estimated directly by estimating equation 5. The discrepancy between the total effects obtained by the substitution process and those obtained directly was considerable. Further, when equation 5 was estimated directly, only 1-3 regression coefficients were statistically significant for each type of institution. Since both the direct estimates and the reduced-form estimates obtained by substitution <u>are</u> in fact based on <u>estimates</u>, the best possible data is required in order to make inferences about the true total effects in the population.

Summary

This paper has suggested a model of all the factors that impinge on changes in net tuition revenue in private colleges. The rather complicated web of those factors contains both the change variables directly involved in the calculation of net tuition revenue and institutional characteristics that affect net tuition revenue indirectly through the change variables. Regression analysis of the system of equations comprising the model provided evidence to indicate the existence of the relationships assumed to connect the variables directly involved in the calculation of net tuition revenue. The regression analysis also suggested the strength and direction of relationships that might exist between institutional characteristics and the change variables. For each type of institution, the exact shape of the web and the various paths along which institutional characteristics could exert an influence on net tuition revenue was different. The exact nature of the web of factors affecting net tuition revenue will clearly need to be investigated further at each different type of private institution.

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